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Key Words: Organisation of Industry; Inter-firm Linkages; Geographical Proximity; Knowledge-Based Economy; Asset Specificity; Principal Component Analysis

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Abstract

Building on Richardson (1972) and on the need of firms to coordinate activities with others in search for related yet different competences, we propose the results of a survey in the Italian Province of Reggio-Emilia (Emilia-Romagna, Italy). Our concerns are related, in particular, with the geography of linkages, their nature, as well as the profile of firms addressing specific types of objectives. Using categorical principal component analysis as well as correspondence analysis, we associate particular groups of motivations with firms' characteristics. Our conclusions support the view according to which the increasing complexity and knowledge intensity of economic activities requires that inter-firm linkages are considered beyond spatial proximity and that knowledge related motivations are associated with specific firms' profiles and patterns of specialisation of activities.

Pourquoi, où et avec qui faut-il s'associer? La nature et
les motivations des liens au sein et en dehors d'un système local italien.

A partir de Richardson et du besoin des entreprises de s'associer pour rechercher des compétences à la fois connexes mais distinctes, on présente les résultats d'une enquête menée dans la province italienne de Reggio Emilia (en Emilia Romagna, en Italie). On porte un intérêt particulier à la géographie des connexions, leur nature, aussi bien que le profil des entreprises qui abordent des objectifs particuliers. Employant une analyse en composantes principales catégorique aussi bien qu'une analyse par concordance, on associe des groupements particuliers de motivations aux caractéristiques des entreprises. Les conclusions viennent à l'appui de l'idée selon laquelle la complexité croissante des activités économiques à intensité de connaissance nécessite que les connexions interentreprises sont considérées au-delà de la proximité géographique et que les motivations qui se rapportent à la connaissance s'associent aux profils et à la spécialisation des entreprises spécifiques.

Organisation industrielle / Connexions interentreprises / Proximité géographique / Economie basé sur la connaissance / Spécificité des biens immobiliers / Analyse en composantes principales

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Verknüpfungen – warum, wo und mit wem? Wesen und Motivation von Verknüpfungen innerhalb und außerhalb eines lokalen Systems in Italien

Silvia Sacchetti

Key Words:
Organisation der Industrie
Verknüpfungen zwischen Firmen
Geografische Nähe
Wissensbasierte Wirtschaft
Vermögensspezifizität
Hauptkomponentenanalyse

JEL classification: C14; D2; L2; R12

Abstract

Aufbauend auf Richardson (1972) und auf dem Bedürfnis von Firmen, auf der Suche nach verwandten, aber unterschiedlichen Kompetenzen ihre Aktivitäten mit anderen Firmen zu koordinieren, stellen wir die Ergebnisse einer Studie in der italienischen Provinz Reggio-Emilia (Emilia-Romagna) vor. Insbesondere befassen wir uns mit der Geografie von Verknüpfungen, ihrem Wesen und dem Profil von Firmen, die sich mit bestimmten Arten von Zielen befassen. Unter Einsatz einer kategorischen Hauptkomponentenanalyse sowie einer Korrespondenzanalyse verknüpfen wir bestimmte Gruppen von Motivationen mit den Merkmalen von Firmen. Unsere Schlussfolgerungen bekräftigen die These, dass Verknüpfungen zwischen Firmen aufgrund der zunehmenden Komplexität und Wissensintensität der Wirtschaftstätigkeiten auch jenseits der Ebene der räumlichen Nähe in Erwägung gezogen werden müssen und dass wissensbezogene Motivationen mit spezifischen Firmenprofilen und mit Spezialisierungsmustern bei den Tätigkeiten einhergehen.

Enlaces: ¿Por qué, dónde y con quién? La naturaleza y las motivaciones de los enlaces dentro y fuera de un sistema local italiano

Silvia Sacchetti

Abstract

Basándonos en las teorías de Richardson (1972) y siendo necesario para las empresas coordinar actividades con otras empresas en busca de competencias relacionadas pero diferentes, proponemos los resultados de un estudio en la provincia italiana de Reggio-Emilia (Emilia-Romaña). Lo que nos preocupa especialmente es la geografía de los enlaces, su naturaleza y las características de las empresas que tienen en cuenta tipos específicos de objetivos. Analizado los componentes principales y categóricos y la correspondencia, asociamos grupos determinados de motivaciones con las características de las empresas. Nuestras conclusiones confirman que para obtener una

mayor complejidad e intensidad de conocimientos de las actividades económicas es necesario que se tengan en cuenta los enlaces entre las empresas independientemente de la proximidad espacial y que las motivaciones relacionadas con los conocimientos se relacionen con las características de empresas concretas y los modelos de especialización de las actividades.

Key Words:
Organización de la industria
Enlaces entre empresas
Proximidad geográfica
Economía basada en el conocimiento
La especificidad de bienes
Análisis de componentes principales

JEL classification: C14; D2; L2; R12

1. Introduction

As an emanation of Marshall's analysis, existing approaches on innovation and learning have long focused on the territorial aspects of knowledge creation and diffusion. The local dimension represents the context where industrial development takes place, and localities have been originally studied following the need to understand processes of agglomeration. Literature on industrial districts and clusters directly refers to the notion of Marshallian externalities (Scitovsky, 1954) which have been associated with high production volumes, a skilled labour force, informal relationships, specialised services and modern infrastructures (Fujita and Thisse, 1996). Such characteristics have played a major role in defining experiences within the boundaries of localities. The same link can be found in innovation literature focusing on innovation systems (Lundvall 1992), which understands processes of learning, upgrading and change as being embedded in the interrelations amongst local actors (Antonelli, 2005), involving firms, local institutions, local associations, schools and universities. The two notions of spatial agglomeration and systems of innovation have been merged at a policy level (UK Parliament, 1997) when promoting, for instance, the establishment and development of science-based clusters, which embrace the idea of grounding agglomeration externalities in the presence of science parks (Longhi 1999) and incubators (Phillips, 2002; Grimaldi and Grandi, 2005).

These insights have been supported by the successful experience of Italian industrial districts, formalized in a model that implicitly identifies networking within a production context spatially defined within local geographical borders, where actors share a common entrepreneurial, social and institutional background (Piore and Sabel; 1984). More generally, given that a central element of clusters is the spatial proximity of firms and supporting institutions, it has been assumed that

relationships within the cluster characterise firms' linkages and networking strategy. However, within a geographical space, firms may engage in a variable number of explicit relationships, which, in an extreme situation, could even be proximate to zero, as in the case of survival clusters (Parrilli, 2007). Differently, networks specifically exist because of the voluntary and strategic coordination of activities between firms, which may eventually exceed local borders.

The complementarity of different activities, in particular, may induce firms to look for linkages that satisfy their objectives and strategies independently of geographical proximity. Literature on regional innovation, specifically, has built on the two concepts of tacit and codified knowledge (Polanyi, 1958). The creation and diffusion of knowledge follows a cumulative and interactive process centred on learning (Lundvall, 1992), during which these two distinct but complementary forms of knowledge overlap. When networks have been considered beyond regional borders, crossing localities and countries, they have been regarded as essentially founded on the exchange of codified knowledge (Cf, for instance Lundvall and Borrás, 1997). As Sacchetti and Sugden (2005) maintain, although codified and tacit knowledge are two faces of the same coin, a duality has been created between proximity and tacit knowledge on the one hand, distance and codified knowledge on the other. This dichotomisation of the spatiality of inter-firm linkages that follows the distinction between the two different natures of knowledge suffers from a static perspective on the location of actors. As a number of authors have pointed out (Sacchetti and Sugden, 2005, Torre and Rallet, 2005), over time spatial distance may give way to spatial proximity, and vice versa.

More generally, this implies that local actors and institutional systems collectively may relate with the wider and sometimes different production dynamics of 'outsiders' (Camagni, 1989), relying on coordination mechanisms that may complement or substitute spatial proximity.[1] Conversely, when

dealing with localised forms of networks within clusters and districts, theory has offered a rather static view of local competences and, as a matter of evidence, it has proven to be insufficient to explain the decline of some of the most celebrated industrial agglomerations, such as those based on traditional industries (Schiuma, 2000).

The recognition of the link between the spatial distance of relationships and the knowledge involved in these relationships, however, does not seem to have been addressed with respect to the nature of the activities involved, which reflect the division of labour across firms and localities. Theory affords knowledge the role of activating endogenous development processes; however this issue "entails also a concern about the quality of knowledge and about who controls the direction that knowledge formation takes across localities" (Sacchetti 2004, p. 390). Building on these broad theoretical considerations, this work empirically addresses three main aspects of networking. In particular, our aim is to understand how the nature of linkages, their geography and governance are related to firms' motivations and activities.

In Section 2, prior to our research question, we offer some further theoretical elements on inter-firm coordination of activities and asset specificity. In Section 3 we provide basic information about the economic structure of Reggio-Emilia, the territory upon which our empirical investigation focuses, together with a description of our survey and sample. In Section 4 we illustrate specific aspects of the nature of inter-firm arrangements. In Section 5, we consider, in particular, the spatial length of linkages, paying special attention to the motivations that underly networking. Using categorical principal component analysis (CatPCA) as well as correspondence analysis (CA), we then associate particular groups of motivations with firms' characteristics, observing in more detail those elements from which we may infer firms' production governance. We present our conclusions in Section 6.

2. Inter-firm coordination, complementarities, and asset specificity

In his seminal paper, Richardson (1972) considers why firms operate in cooperation; he provides the basis for explaining different modalities in the 'organisation of industry'. The essence of Richardson's analysis is that the firm and the market are not the only means for co-ordinating production, as Coase (1937) has been argued to suggest, rather that a third possibility is 'complex networks of co-operation and association' (Richardson, 1972, p. 892) amongst and across firms.

As inter-firm linkages represent a further form of organisation of industry, an understanding of why one form of co-ordination emerges instead of another links back to the notions of knowledge, experience and skills. In the 1972 article, the distinction between similar and complementary activities leads to an explanation of why firms might choose inter-firm co-operation instead of central planning or market transactions. Richardson (1972) paved the way for more recent contributions on the motivations that may be at the heart of inter-firm coordination. The idea of building relationships that bring in to firms new complementary knowledge is grounded on the competence-based view of firms (Prahald and Hamel, 1990; Teece and Pisano 1994), which was originally introduced by Penrose's analysis (Penrose, 1959). These earlier perspectives have clear insights when interpreting the debate around what has been called the 'knowledge economy', which 'refers to an economy and its sectors in relation to the intensity of human knowledge capital employed and of technological inputs purchased' (Cooke, 2005, p. 19). Industrial development and the strategies to achieve it have recently been re-thought in the light of the context offered by these elements (Amin and Cohendet, 2000; Lissoni, 2001).

Following the competence-based approach, 'a primary role of the organisation becomes that of co-ordinating the dispersed knowledge' (Amin and Cohendet, 2000, p. 97). Therefore, a focus on knowledge and on the organisation of production includes – amongst other issues – collaborative organisational solutions, such as networks, their governance, as well as firms' strategies with respect to technology and innovation processes. According to this view, networks can stretch firms' competences by means of complementary partners (Chetty and Blankenburg, 2000). In this context, learning offers a dynamic perspective on the implications of networking (Parrilli and Sacchetti, 2006). Because learning is essentially a cognitive phenomenon generated also through interaction and socialisation, repeated contacts and joint work can activate the cognitive resources of individuals and organisations, thus originating new experiences and routines (Nelson and Winter, 1982). Therefore, following the competence view, networking can be beneficial – amongst other things – because it may stimulate communication and convey new stimuli towards firms, thus enhancing learning opportunities (Håkansson and Ford, 2002), possibly leading to technological upgrading and improved competitiveness (Humphrey and Schmitz, 2002).

However, as Sacchetti and Sugden (2005) emphasise, the activation of such a learning process is not disjoint from the nature of relationships. In the case of recent evolutionary trends in industrial districts, most of the emphasis is on the role of the leader firm to promote the technological upgrading and competitiveness of mature and stagnating sectors (Brioschi et al, 2002). Although considerations of this kind offer an analysis of the benefits of the leader-firm model, networks centred on a core firm suffer from a 'participation lacuna' with respect to governance issues (Sacchetti and Sugden, 2003).

Besides competence complementarities, therefore, we consider the elements that impact on a firm's range of possibilities. In particular, asset specificity, considered both in terms of the knowledge incorporated in physical as well as in intangible capital, directly impacts on the balance between internal coordination of resources and specialisation with respect to others (Langlois, 1998). Knowledge, in particular, represents a specific asset that requires commitment (both in terms of financial resources and time invested in the creation, transmission and reproduction of knowledge) and internal coordination (such as in the process of knowledge socialisation and codification). Therefore, the creation of competences is also subordinated to the capacity of firms to commit themselves to the acquisition and maintenance of specific pieces of knowledge capital. Again building on Richardson (1972), the more complementary pieces of knowledge are dissimilar, the greater is the commitment that adding a new piece of internal competence requires. On the one hand, highly specific assets require commitment and internal co-ordination, whilst competence complementarities in production may require external co-operation. The definition of firms' linkages, in this sense, may generate and be generated by a trade off between co-ordination and flexibility whenever complementary activities require highly specific investments both in terms of physical capital and knowledge (Langlois, 1998). As Langlois (1998, p. 192) observes, however, the distinction of the elements that generate a trade off is not so neat, as indeed both alternatives (internal direction or external co-operation) imply some sunkness: one relates to the sunkness internal to the firm; the other refers to the degree of specialisation of activities with respect to others.

Linked to issues of customisation and asset-specificity, networking strategies by firms directly affect the degree of dependence on partners or, vice-versa, the degree of control potentially exercisable on others (Palpacuer, 2000; Sacchetti and Sugden, 2003). Building on the notion of

flexible production, however, networks have been presented as organisational forms that maximise flexibility to changes in the competitive environment (Jarillo, 1988) without examining, as Markusen (2003, p. 710) sharply emphasises, 'the motivations of participants, mapping who might be included and excluded, analysing unequal power relationships among members or gauging the durability or fragility of relationships'.

Following these broad concerns, our analysis addresses networking issues wherever connections amongst firms arise. From a methodological point of view, this positions our contribution on a different ground with respect to studies with a more immediate focus on local ties, an approach which has inappropriately eliminated linkages outside the region from the analysis (Markusen 2003). In contrast, as our first research hypothesis, we expect to find linkages on a multiplicity of spaces (local, national, international) and – particularly regarding knowledge-related activities, such as innovation and R&D – we hypothesise that linkages might occur irrespective of spatial closeness.

Our second hypothesis is that different specialisations within and across sectors are associated with diverse network motivations. In particular, we would expect to observe knowledge-related motivations with a higher frequency where activities encompass a higher level of knowledge content. In parallel, we expect knowledge-related motivations to be more frequent when knowledge obsolescence might require linkages that help the firm to renew internal competences or to escape from local idiosyncratic patterns of localised knowledge relationships that lead to lock-in (Arthur, 1988).

Related to this, as our third hypothesis, we expect that different types of partners (for example, large vs. small firms; prime contractors vs. subcontractors; headquarters vs. subsidiaries), or linkages (for example, with respect to the nature of the agreement) also entail different motivations. In particular,

we expect to observe varying levels of knowledge-related arrangements according to the position that partners occupy in the structure of the network (Sacchetti and Sugden, 2003).

3. Context and sample

Our empirical data focuses on firms in Italy within the Province of Reggio Emilia. This province is characterised by a mature industrial tradition in: metal products; construction of machineries; food industry; ceramics; textile and clothing. Since the mid 1990s employment and productivity levels have been subject to a number of fluctuations, which have been said to be related to the increasing internationalisation of the local production base (Assindustria-Antares, 2000). In parallel, the maturity of manufacturing sectors (which, in some sectors, was reached already in the 1970s) (Basini, 1999), together with recent diversification strategies pursued by some leader firms, accelerated a process of concentration through the creation of conglomerate groups that tackle multi-product markets (Assindustria-Antares, 2000).

Our analysis is grounded in a larger survey undertaken in 2000 whilst fulfilling a research requirement for Assindustria, the local industrial association.[2] Our data concerns three aspects of inter-firm relationships: 1) the nature of linkages; 2) the objectives of inter-firm cooperation either within or outside their locality; 3) the profile of firms involved with long-distance linkages.

The survey addressed almost all manufacturing firms with over 10 employees and a postal questionnaire was sent to 1670 manufacturing firms in the province.[3] After replies, we relied on 155 cases. This is, therefore, a 'nonprobability sample' (Churchill 1995), partly accidental as 115 replies refer to questionnaires returned by post on a voluntary basis, and partly purposive as 40 firms were hand-picked and questionnaires were filled during direct meetings with entrepreneurs or senior

managers. Questionnaires were, in part, submitted during direct meetings as a strategy to increase the accuracy of the replies and, in part, as a strategy to tackle the most representative Assindustria associates, which are mainly large firms.[4] For these reasons, the sample, overall, includes a higher proportion of firms with over 50 employees with respect to the population.[5] However, the design of the sample reflected our interest in studying relationships amongst specific firm characteristics and strategies. Consistently, the sample, as Corbetta (1999) notices, may not reflect an exact representative balance of all firms.

In line with the notion of knowledge economy, differences in networking motivations can be further appreciated by distinguishing production according to the knowledge intensity of labour, technologies and products. We approximate the hypothesis that sectors differ in the rate and modalities of innovation using Pavitt's classification (Pavitt, 1984), which distinguishes industries where firms rely on the technology produced by other sectors from those where firms support production with internal R&D. According to this main criterion, sectors are classified as follows: 'supplier-dominated' (textiles and clothing, food, wood products and furniture, non-metallic mineral products, basic metal industries); 'scale-intensive' (paper products and printing, chemicals excluded drugs, rubber and plastic products, iron and steel, shipbuilding and repairing, motor vehicles); 'specialised suppliers' (non-electrical machinery, electrical machines, radio, TV and communication equipment, control equipment); 'science-based' (drugs and medicines, office and computing equipment, aircraft, professional goods). We use this classification as an interpretative key for our data and, in line with our earlier discussion, we would expect network motivations to change across sectors with different degrees of knowledge intensity. For this purpose, we have identified firms using, with minor adaptations, the classification from the OECD STAN database for industrial analysis.

In addition, we look for significant relationships between network motivations, the size of firms,[6] and their age. Together, these three categories emphasise the distribution of respondents with respect to the magnitude of past experience (age), their organisational characteristics (size), as well as their knowledge intensity and potential (sector). These characteristics, are then related, when relevant, to the nature and scope of linkages of respondents.

4. The Nature of inter-firm arrangements

Inter-firm co-operation occurs mainly through formal arrangements: contracts and equities together are adopted by 80% of firms (Figure 1), which prove to characterise linkages with prime contractors (Table 1).

FIGURE 1 ABOUT HERE

TABLE 1 ABOUT HERE

Still, informality characterises inter-firm agreements for 50% of firms. This relational ability (or strategy) characterises legally independent firms[7] as against firms owned by a parent company. Contrary to our expectation, size is not important.[8] Informality, moreover, does not seem to exclude other kinds of arrangements, such as entering into contracts with other firms (0.266 correlation) or integrating strategy by means of equity holding (0.422). This double nature of arrangements could be seen as a reflection of the fact that linkages are firm specific: each firm, given its relational abilities, can build multiple relationships characterised by more or less informality. The mix can

vary over time, according to firms' strategies. This coexistence requires different management and might be chosen, for instance, to allow greater flexibility when, because of environmental uncertainty and complexity, relationships rely on socialisation rather than market or bureaucratic control (Palpacuer, 2000; Ouchi, 1980). The nature of relationships can change as well. Firms might chose to redefine their position with respect to partners, perhaps building on mutual trust as it emerges over time, on the competences acquired and knowledge complementarities (Parrilli and Sacchetti, 2006). This may either originate specific routines, or in input customisation and idiosyncratic assets that imply setting up new contractual arrangements (e.g. through the creation of formal agreements or by exchanging proprietary assets).

Linked to this, we looked at the characteristics of linkages established by firms that base their relationships, amongst other things, on equities. Although these firms are a small fraction, the analysis returns significant correlations (Table 2).

TABLE 2 ABOUT HERE

Where linkages are structured on shareholding, size is not significant. The network develops along long-distance connections, for instance by means of associated firms or JV agreements, following motivations that imply high levels of idiosyncratic investments with respect, for instance, to production plants for the realisation of scale economies and technological transfer, or the transfer of strategic knowledge in terms of patents, innovation and R&D. This seems to support the idea that when the commitment in terms of investments and knowledge is high, firms tend to create a property rights system that allows them to participate in strategic decision making processes that are

related to their own activity whilst, in parallel, appropriating the production surplus that derives from joint activities.

5. The objectives of inter-firm co-operation

The motivations underneath inter-firm co-operation at the country level involve most frequently sourcing, distribution and marketing agreements amongst firms (Figure 2). Training and recruitment of personnel, together with the development of R&D activities and the introduction of innovation, are addressed by more than 40% of respondents. This suggests that firms confer to the production (through R&D) and reproduction (through training) of knowledge a central role for the evolution of production activities.

FIGURE 2 ABOUT HERE

Co-operation at the country level for licensing or for the development of patents is less frequent (10.3%), which might be an indication of the fact that, on intangibles, firms might prefer to develop individual strategies. On this, we observe a greater tendency of firms to co-operate with foreign partners. If we relate, for each of the objectives, the frequency of firms that have foreign partners with that of firms that rely upon national partners, we observe that the competences and opportunities offered internationally assume more relevance also for distribution and marketing, technical co-operation, business growth, R&D and innovation.[9] We expected marketing and distribution to be amongst the relevant motivations of foreign partnerships, since firms who want to sell internationally increasingly outsource logistic and distribution services (Dicken, 2007). Technical co-operation, business growth, R&D and innovation, on the same geographical scale, are also pursued across countries, implying that geographical distance might not prevent from building

long distance linkages, in particular when referring to activities mainly grounded on knowledge exchanges.

5.1 Associations between network motivations

The analysis of associations between network motivations is based on data reduction techniques, which allow for better interpretations of results when including a limited number of variables. Having to choose between the motivation listed in Figure 2, we included those which refer to the production and distribution of knowledge (namely, training and recruitment, R&D and innovation, technical co-operation, licenses and patents), to uncertainty (finance and risk sharing), as well as to those motivations with the highest frequency (namely distribution and sourcing).

Motivations related to the creation or to the diffusion of knowledge (underlined in Table 3) are positively and very strongly associated. The association is strongest when knowledge objectives are pursued across national borders. The cohesion of this group of objectives suggests that increasing and renewing the knowledge base of firms is a priority that fits very well with the establishment of linkages within and especially across borders. Linkages that aim at raising equities and sharing risk are especially relevant in these respects. The intensity of the relation increases when knowledge related activities are undertaken with foreign partners. In particular, R&D undertaken with foreign partners scores very high with technical co-operation, risk sharing and training programmes with foreign partners. Technical co-operation abroad, in turn, is very highly associated with financial arrangements, risk sharing, licensing and training. Licensing agreements, both nationally and internationally, are strongly associated with financial and risk sharing arrangements.

Moreover, correlation coefficients emphasise that firms having an international network of clients and suppliers are also much keener on learning intensive activities with other firms both over national and international distances.

TABLE 3 ABOUT HERE

Essentially, firms appear to be divided in two macro groups: those that have built any of the above mentioned linkages whether nationally or internationally, and those which have not. Amongst the former, firms can be divided between those which have established learning-related linkages and those which focus on sourcing and distribution.

FIGURE 3 ABOUT HERE

This view is suggested by a correspondence analysis on network motivations. The plot in Figure 3 shows the existence of a strong correlation amongst these three groups of motivations:[10]

- ✓ sourcing and distribution with partners located within the country
- ✓ technical co-operation, licensing, and finance both at the national and international level with international distribution
- ✓ R&D and training objectives both at the national and international level with sourcing and distribution on an international scale

In particular, the graphical output in Figure 3 suggests that international sourcing and distribution are associated with other learning oriented activities.

With principal component analysis, similarly, we can simplify this complex set of data by measuring the level of association between groups of items (variables) and some latent dimensions (or components). Essentially, a dimension is a 'condensed statement of the relationships between sets of variables' (Kline, 1994, p. 5). Table 4 illustrates the results of principal component analysis.[11] For each variable we report the correlation with the components. These correlation indexes are called 'loadings' and measure the association of the variable with the component.[12] The meaning of each component has to be deduced from the component loadings. From the latter, we can observe at least three dimensions[13] which can account for the correlations between network motivations.

TABLE 4 ABOUT HERE

Component 1 loads[14] more highly with risk sharing objectives both with foreign and national actors. Networking aiming at the creation of knowledge through R&D is consistently oriented also at the distribution of knowledge through training or, for example, programmes for the mobility of personnel. At the same time, linkages are aimed at sharing risk, an aspect which proves to be highly relevant when firms undertake uncertain activities such as R&D.

Component 2, by the same process of deduction used above, identifies financial arrangements with national partners. This scores highly also with licensing arrangements at the international and national levels, training and recruitment of personnel and distribution agreements with foreign partners. We are referring to a group of objectives that is pursued by firms that, possibly, tend to

build linkages based on shareholding. The property link, in turn, opens possibilities in terms of licensing, training, as well as marketing and distribution abroad.

Component 3 identifies essentially technical co-operation pursued in partnership both at the national and international level, which is paralleled by licensing agreements and R&D. For all three components the association amongst the variables is strong and significant (Table 3), thus suggesting validity of these results for the entire Province.

5.2 The profile of firms with respect to international networking

An analysis of the associations amongst network motivations has identified some similarities amongst groups of objectives. This leads to a concern with characterising the production governance of firms associated with these groups of objectives. In particular, we focus on linkages that span across national borders. We look at major correlations between variables describing production linkages (linkages for sourcing and distribution), knowledge dynamics (such as the presence of an R&D centre inside the firm, research oriented arrangements between firms, technological transfer, licenses and patents, the generation of spin-off firms) and variables that operationalise the nature of governance in production (such as whether the firm is linked to a parent company, the presence of subsidiaries and the degree of control exerted on them as well as their location).

Contrary to our expectations, none of the motivations is significantly correlated with size, with the sector or with the age of firms[15] (Table 5). This result can be possibly related to the size of firms in

our sample, where the average size of firms is 365 employees and 65% of firms have less than 51 employees.

TABLE 5 ABOUT HERE

Long-distance linkages, moreover, are not significantly associated with firms linked with a parent company (Table 5), whilst they are weakly but significantly correlated with firms that have subsidiaries. This suggests that strategic decisions on international networking with respect, in particular, to R&D and innovation, sourcing and distribution, and finance, are taken by legally independent firms with an enlarged organisational structure and that, oppositely, being a subsidiary cannot be related to international networking strategies.

As it emerges from Table 5, firms with an international network spanning from sourcing to knowledge related activities can be clearly identified with locally based prime contractors that organise their production on an international scale and, to a lesser extent, with firms linked with foreign prime contractors. With respect to the latter, local prime contractors are involved to a greater extent with learning related activities.

The profile of firms that emerges from associations between variables shows also that an internal R&D centre is not a necessary condition for firms to settle international linkages. This result suggests two considerations. The first is that firms learn how to communicate on scientific matters building their knowledge also outside dedicated R&D structures; the second, perhaps complementary, is that firms that do not organise their research within an internal centre may balance this absence with long-distance linkages.

Long-distance linkages usually imply shareholding and, when strategic knowledge is involved, this attitude is reinforced. The control over strategic knowledge seems therefore to be linked with proprietary control and to the possibility to shape actively strategic decision making on these issues. Consistently, the knowledge and learning potential accumulated by these firms is not associated with spin offs, probably meaning that the territory does not benefit directly from international linkages through the creation of new local independent firms, or that such a process requires more time.

6. Conclusions

Our results support the hypothesis that linkages occur on a multiplicity of spatial levels and that international networking assumes relatively more relevance with respect to national linkages, especially when inter-firm arrangements are concerned with knowledge intensive activities. Moreover, when facing complex systems of knowledge, networking within and outside the locality becomes a fundamental element that shapes the organisation of production across organisations and localities.

These results emphasise elements of inter-firm relationships that, as we observed, are sometimes disregarded when promoting local industrial development focusing on geographical proximity. Moreover, when facing complex systems of knowledge, networking becomes a fundamental element for the organisation of production. The space of relationships where knowledge complementarities are aggregated may be local, but it can also bypass national borders.

Besides, the relevance of knowledge related motivations shapes the type of arrangements underlying networking. Because external cooperation implies some degree of internal and external sunkness, firms tend to strengthen their knowledge-based linkages through shareholding and proprietary control.

We also hypothesised that different types of sectors and activities within sectors are associated with distinct network motivations and, specifically, that knowledge related motivations are more frequent where sectors and activities include higher levels of knowledge. Results on these issues can be split into two. With respect to industrial sectors, the analysis of correlations has shown that the knowledge intensity of sectors does not explain the motivation or the spatial length of network linkages. Differently, however, the specific activities or functions of firms are more relevant when looking, over long distances, at learning and knowledge related linkages. Our analysis has shown that knowledge and learning motivations are associated with one another, and that this association is stronger when linkages are across borders. In particular, firms with an international network that includes knowledge related activities can be identified with locally based prime contractors that organise their production on an international scale. Conversely, firms pursuing mainly sourcing and distribution at the local level are not, in general, associated with knowledge related activities.

Finally, we wanted to look at the governance of production linkages and how this relates to motivations. In particular, we hypothesised that knowledge-related motivations vary according to the position that firms occupy in the structure of the network. The analysis of correlations has shown that the size of the firm as well as its age do not seem to matter in explaining the spatial length and motivation of network linkages, nor in explaining the governance structure of the firm, e.g. a multiplicity of production sites, the creation of subsidiaries or control by a parent company.

Our findings suggest that decisions on international networking with respect to knowledge related issues are taken mainly by independent firms with an enlarged organisational structure (parent companies with subsidiaries) and that, conversely, subsidiaries tend not to have their own networking strategy. In general, moreover, long distance linkages are associated with shareholding and, when strategic knowledge is involved, this attitude is reinforced.

More generally, our data support the view that knowledge related linkages develop across industrial systems that are not established around firms with a narrow local focus but around organisations that can offer specific competences to others beyond their local context. Therefore, whilst it is relevant to encourage networking amongst firms and production systems, policy makers and firms should discriminate amongst patterns of specialisation and linkages that allow for searching knowledge complementarities and those that, conversely, narrow firms' competences to lower learning profiles – such as in the case of pure subcontractors.

Besides, and in furtherance of the considerations stemming from our last hypothesis, policy should consider that inter-firm linkages centred on knowledge are mainly accomplished by firms that retain some degree of strategic decision-making power. This idea is rooted in the strategic decision-making approach (Cowling and Sugden, 1994). Building on it, Sacchetti (2004) recognises that the fundamental issue that links internationalisation of production and the formation of knowledge capital across different localities is the uneven distribution of decision-making power with respect to technologies, educational programmes and innovation-related activities. From this perspective, there is a sense in which the recognition of the link between the division of labour across firms and localities and knowledge diffusion should be re-considered carefully by economists and policy makers. The identification of differences across localities must also acknowledge their function

within the international division of labour, the nature of specific production activities, as well as the hierarchy of powers associated with these activities.

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Table 1: Location of prime contractors and type of agreement. Measures of association.

	Equities	Contracts
Links with local prime contractors	0.336	0.236
Links with national prime contractors	0.407	0.347
Links with foreign prime contractors	0.380	0.374

Valid cases: 102

Table 2: Significant correlation indexes with linkages based on equities (in order of importance)

		Valid cases	Linkages based on equities
1.	Linkages with foreign partners in JV	102	0.599
2.	To reach critical mass (scale) with foreign partners*	90	0.384
3.	Licensing, patents with foreign partners*	92	0.376
4.	Technical cooperation with foreign partners*	91	0.366
5.	R&D, innovation with foreign partners*	90	0.355
6.	The firm is partner in JV	96	0.349
7.	Technical cooperation with Italian partners*	91	0.345
8.	Licensing, patents with Italian partners*	92	0.339
9.	Distribution and marketing with foreign partners*	92	0.312
10.	To reach critical mass (scale) with nation-based partners*	90	0.304

Correlations are calculated using Cohen's kappa correlation index.
* Objectives pursued by means of linkages.

Table 3: Measures of associations amongst network motivations

	R&D f	R&D i	Tech f	Tech i	Trai f	Train i	Lice f	Lice i	Fina f	Fina i	Risk f	Risk i	Sour f	Sour i	Dist f	Dist i
R&D f	1															
R&D i	0.687	1														
Tech f	0.808	0.592	1													
Tech i	0.709	0.635	0.826	1												
Train f	0.784	0.612	0.857	0.751	1											
Train i	0.590	0.541	0.577	0.528	0.616	1										
Lice f	0.735	0.581	0.883	0.813	0.844	0.556	1									
Lice i	0.704	0.634	0.821	0.780	0.796	0.577	0.910	1								
Fina f	0.754	0.570	0.906	0.796	0.893	0.575	0.892	0.843	1							
Fina i	0.723	0.636	0.792	0.693	0.780	0.660	0.893	0.855	0.850	1						
Risk f	0.790	0.559	0.865	0.782	0.906	0.564	0.878	0.855	0.930	0.811	1					
Risk i	0.746	0.601	0.869	0.788	0.882	0.566	0.856	0.833	0.906	0.815	0.946	1				
Sour f	0.713	0.576	0.756	0.694	0.732	0.498	0.743	0.711	0.775	0.697	0.762	0.742	1			
Sour i	0.491	0.519	0.458	0.493	0.420	0.480	0.439	0.447	0.441	0.511	0.469	0.486	0.520	1		
Dist f	0.592	0.558	0.575	0.558	0.606	0.530	0.606	0.618	0.604	0.562	0.593	0.595	0.520	0.642	1	
Dist i	0.468	0.559	0.445	0.498	0.418	0.490	0.463	0.508	0.438	0.506	0.448	0.483	0.520	0.468	0.636	1

Valid cases: 107

*Cohen's Kappa. Correlation coefficient estimates based on 155 observations (min = -1, max = +1, no association = 0). All reported correlations are significant at the 0.01 level; Emphasis is on correlations that are relevant to validate correspondence analysis. Abbreviations: R&D f/i: R&D and innovation with foreign/Italian partners; Tech f/i: Technological cooperation with foreign/Italian

partners; Train f/i: Training and recruitment with foreign/Italian partners; Lice f/i: Licensing and patent with foreign/Italian partners; Fina f/i: Financial agreements with foreign/Italian partners; Risk f/i: Risk sharing with foreign/Italian partners; Sour f/i: Sourcing agreements with foreign/Italian partners; Dist f/i: Distribution and marketing with foreign/Italian partners.

Table 4: Principal components of networking motivations: component loadings*

	Component		
	1	2	3
Risk sharing For	0.783		
Risk sharing It	0.702		
Training, recruitment For	0.694		
R&D, innovation For	0.559		
R&D, innovation It	0.432		(0.329)
Finance It		0.774	
Licensing, patents It		0.751	(0.314)
Licensing, patents For		0.609	(0.563)
Finance For		0.465	
Training, recruitment It	(0.403)	0.461	
Technical co-operation It			0.780
Technical co-operation For			0.583
Distribution, marketing It			
Sourcing It			
Sourcing For			
Distribution, marketing For		0.429	

Total cases used in the analysis: 107
Extraction method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. For: with foreign partners; It: with Italian partners (country level).

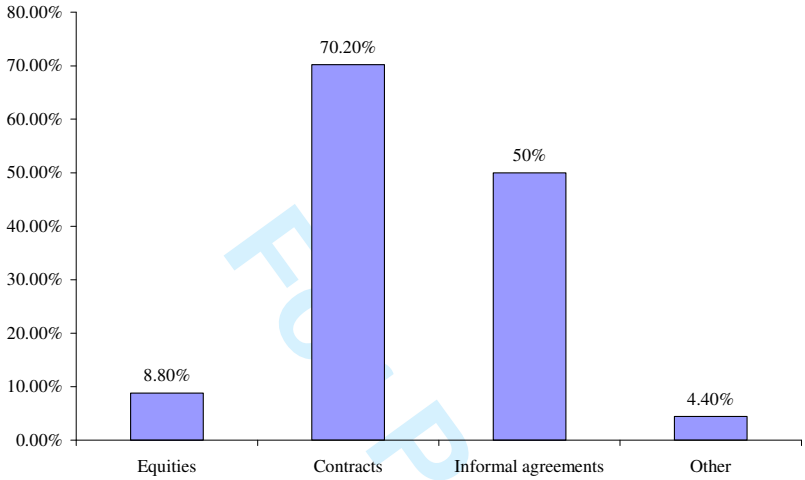
*Another principal component analysis was calculated using the complete list of motivations, including green technologies, recycling, business growth, and the residual option 'other'. In this analysis most of the variability of the model was explained by the variables with the lowest frequency, e.g. environmental variables, which did not allow us to interpret possible combinations of other variables. For this reason we have preferred to exclude them from the analysis.

Table 5: The profile of firms with respect to international networking

	Valid Cases	Sourcing	Distrib.	R&D	Tech.	Licensing	Finance	Training	Risk
Age^		-	-	-	-	-	-	-	-
Size^		-	-	-	-	-	-	-	-
Pavitt^		-	-	-	-	-	-	-	-
Multiple production sites		-	-	-	-	-	-	-	-
Firms with subsidiaries♣	104	0.109	0.150	0.173	0.072*	0.064*	0.111	0.096	0.058
Link with a parent co. ♣	104	-	0.092*	-	-	-	-	-	-
R&D centre♣	105	0.146	0.138	0.199	0.133	0.089*	0.074*	0.120	0.081*
Reg. patents♣	103	-	0.131	0.076*	-	0.062	-	-	-
Links with foreign prime contractors ♣	93	0.302	0.475	0.316	0.312	0.321	0.295	0.280	0.273
Links with foreign subc. ♣	94	0.477	0.371	0.426	0.374	0.384	0.408	0.374	0.379
Equity agreements	92	0.319	0.312	0.355	0.366	0.376	0.386	0.353	0.381
Spin-offs♣		-	-	-	-	-	-	-	-

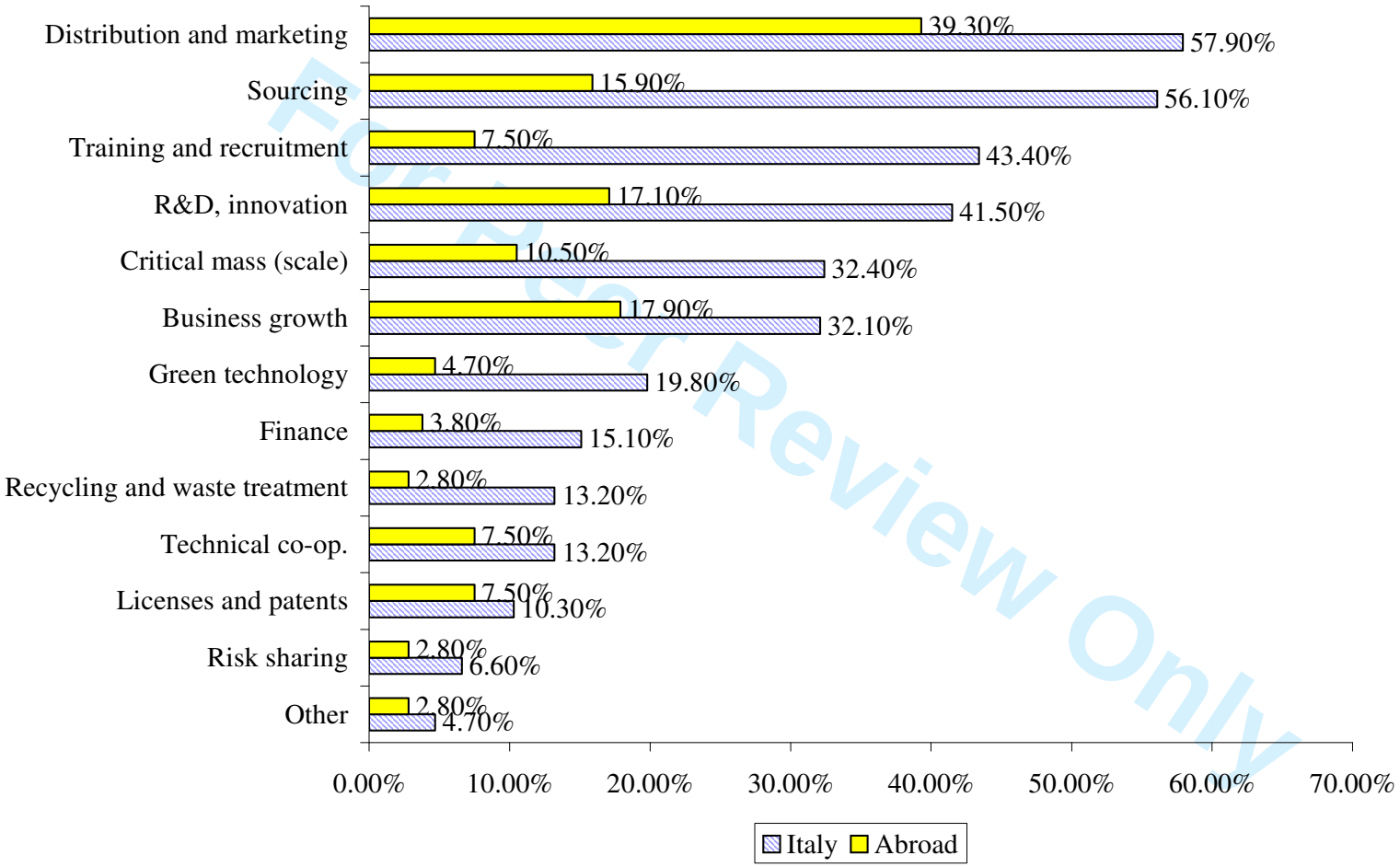
(^) Goodman Krusal correlation index; (♣) Cohen's Kappa correlation index;
Non-flagged correlations are significant at the 0.01 level; (*) correlation is significant at the 0.05 level.
(-) there are no significant correlations

Figure 1: Frequency (%) of inter-firm arrangements



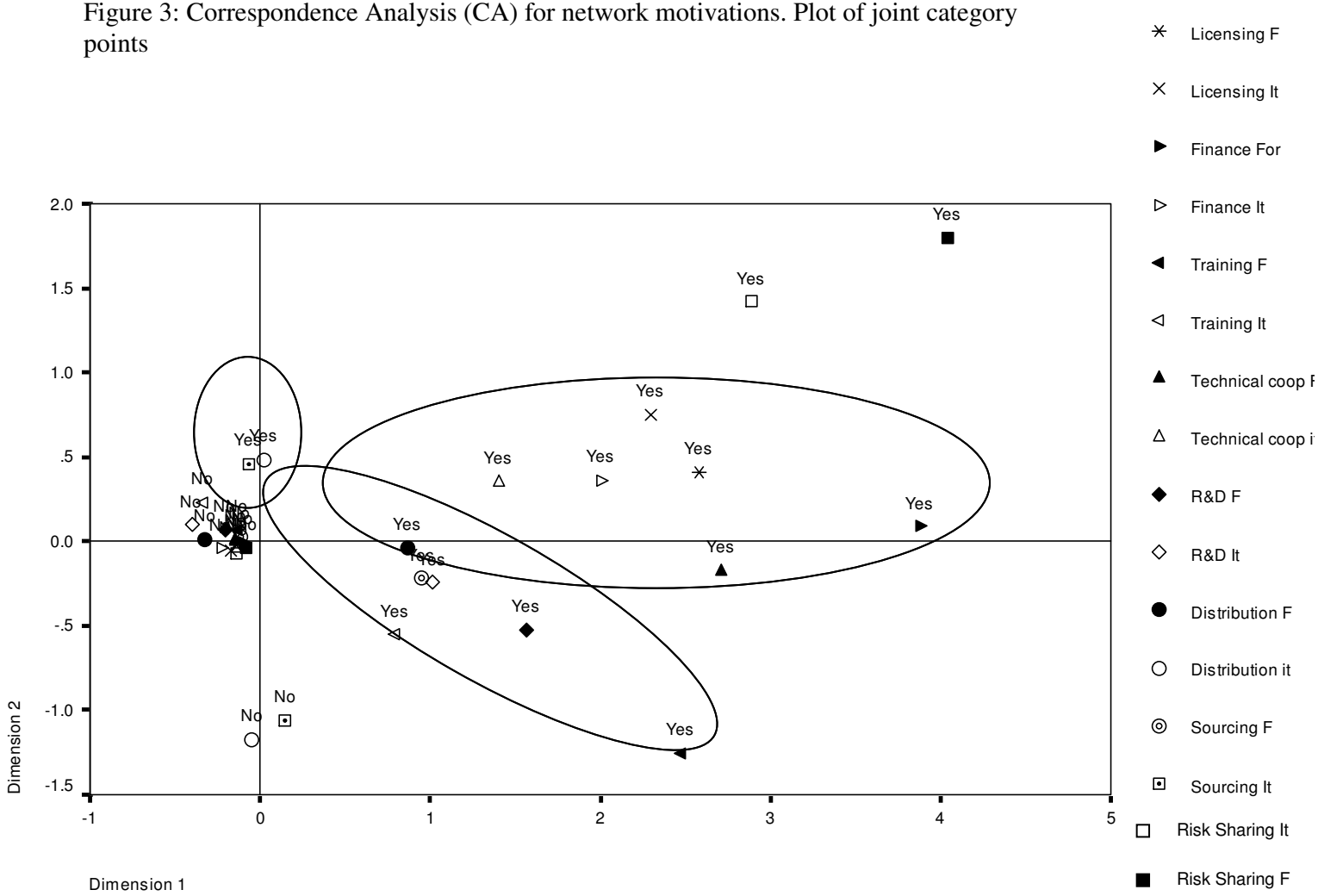
Valid cases: 114

Figure 2: The objectives of inter-firm co-operation with partners located within the country and abroad (% frequency amongst respondents)



Valid cases: 107

Figure 3: Correspondence Analysis (CA) for network motivations. Plot of joint category points



Valid active cases: 104; active cases with missing values: 51; total number of cases: 155

Appendix - Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	2.503	15.644	15.644
2	2.416	15.098	30.742
3	1.724	10.776	41.518
4	1.484	9.274	50.791
5	1.467	9.166	59.958

Extraction Method: Principal Component Analysis.

All eigenvalues above 1 have been selected and then the rotation has optimised the amount of variance explained by each of the five components. The first three components show robust results with respect to reliability analysis (alpha).